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## NETCONNECT – CONNECTING EUROPEAN CULTURE THROUGH NEW TECHNOLOGY

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**Abstract** – This paper illustrates the aim of the NETConnect project to provide a broad view of cross-site cultural connections of three prominent European archaeological sites. The project creates an IT infrastructure capable of providing the public with a wide range of experiences, ranging from the interaction with on-site mobile devices to geo-referenced real-time 3D visualisation systems. The aim is to promote a more entertaining yet effective educational process which can engage the visitor during his/her visit to the site.

## INTRODUCTION

Cultural production and entertainment centres are among the major industrial leisure resources, catalysts of interest, multipliers of business, as well as instruments for the re-qualification of the archaeological and Cultural Heritage. The possibility to visit an archaeological landscape or site while experiencing its reconstruction interactively at the same time makes the overall experience more engaging, culturally enriching and entertaining for visitors. In fact, archaeological sites and ancient monuments are usually perceived by non-experts as fragmented, partial, difficult to interpret and understand, and out of the contemporary age context. This results in a frustrating and limiting experience for many visitors. The curators of archaeological sites have tried to improve the experience making textual information, drawings showing how the site looked like in ancient times and physical models of ancient monuments available to the public. These are all very limited attempts to overcome the lack of information and context experienced by visitors, who have also required a significant amount of time with questionable results from the expert point of view.

On the other hand, new Information and Communication Technologies (ICT) have not been fully exploited to increase the awareness and the engagement of the general public visiting the site. Current visitors look for interactive and mobile tools to access data on demand about the cultural background of the site, artistic aspects, historical context and other valuable information that enrich their experience. At the same time, visitors should relate their visit to other culturally similar or related archaeological sites in order to build a wide picture of cultural and stylistic interrelations between various sites in Europe.

The NETConnect project is supporting this vision of a cohesive culturally interconnected European Heritage using the available new technology, creating a central hub for accessing archaeological content, which also will support more engaging communication and visualisation means than 2D static content.

To guarantee a fruitful achievement of the NETConnect goals, the NETConnect consortium consists both of archaeological partners – bringing in their archaeological expertise – and technical partners from various research organisations having a strong insight on state-of-the-art technologies. Through the strong collaboration between these complementary research fields NETConnect aims to build the base for a fruitful Pan-European cultural network and to promote the mutual understanding of these complementary research fields, thus enabling a stronger collaboration between Electronic Information sciences and archaeology.

## GOALS

As visitors often cannot access the information available on site due to the lack of interoperability or proper media, NETConnect tries to overcome such gaps by providing:

- Internet and desktop-based virtual environments, mobile and GIS applications representing three archaeological sites across Europe.
- Harmonisation and spreading of know-how and successful benchmarking cases on the use of ICT in Cultural Heritage in order to address the need to control the physical impact of mass tourism on cultural assets.
- Low-cost and wide access to cultural content by the broad public, including young, elderly and disabled people, aiming at mutual understanding between cultures.

- Advertisement and promotion of tourism in archaeological sites and the cultural scenarios.

Based on three archaeological sites and their surrounding landscape, the project will develop a sustainable methodology for connecting the sites as a basis of a European network. In fact, the results of the project will be applied to three major EU archaeological sites: the Magna Graecia of Calabria, in the south of Italy, Glauberg in Germany and Biskupin in Poland. These three sites will thus become the main core of a network of interconnected cultural scenarios.

Throughout the project, archaeologists will ensure historical accuracy of the virtual reproductions of the scenarios working in close collaboration with the technological partners during the virtual reconstructions. The three archaeological sites will provide audiovisual content and will assess the effectiveness of prototype applications by setting the requirements and by providing relevant feedback during test phases. Moreover, the formalisation of the interconnection between scenarios will become the basis of the work of the technological experts.

The main objectives of NETConnect can be summarised as follows:

- Sharing and highlighting common Cultural Heritage of European significance, promoting mutual knowledge of culture and history of European people.
- Using state-of-the-art technology to make European heritage more visible and accessible to all.
- Improving access to and experience of culture using new technologies for European citizens, including young, elderly and people with physical impediments.
- Public relations and cooperation activities between cultural operators and technological experts in order to disseminate European culture through the newly established International network.

## **RELATED WORK**

During the last decades, a great number of projects related to the application of innovative technologies to Cultural Heritage have been implemented. Some European projects have assessed some of the most outstanding technologies: 3D digitalisation and scanning techniques have been used for the reconstruction of historical objects [2], Virtual and Augmented Reality technologies allow new interaction ways for users and experts [3,4], mobile devices and multimodal interfaces provide intuitive and personalised access to scientific information from museums and archaeological sites.

Although these applications have improved the diffusion and dissemination of Cultural Heritage, most of the projects have not been implemented in concrete scenarios. In order to transform these approaches into successful commercial products, the focus should shift from a pure technological point of view into an integrated process for the generation and management of content. Multimedia guides must support important personalisation of the content owned by a cultural institution in order to provide users with a visit in accordance with his/her background. At the same time, a guide for a museum or exhibition room should encourage learning and personal enrichment.

Therefore, information should be displayed taking into account the physical location of the visitor as well as the position of the artworks in their natural environment. The

overall experience can be optimised by the connection between the information of the exhibition and the presentation to the visitor in a coherent way depending on the location.

Museums have used portable electronic guides since the 50s. However, even nowadays, these guides are a research issue with quite a few publications about the use of portable computers. Although they have already a long history, electronic guides or ebooks still have to face great challenges. One of the outstanding one is to understand the objective of the visit to a museum or an exhibition. Many projects have explored new possibilities provided by Personal Digital Assistants (PDA) in cultural organisations. Currently, multimedia guides display static images or pre-recorded videos about the artworks of the exhibition.

Electronic books are appropriate tools for the display of information and the dissemination of content in order to allow interacting with objects within the exhibition and creating a social experience. The Sotto Voce [5] implemented by Xerox analyses the use of these technologies in exhibitions. This project has been validated in different exhibition rooms of Filoli, an historical house in Woodside, California. Each visitor carries a Compaq iPAQ device with tactile screen, a wireless card with Internet protocols and a single-ear. It has been observed that if visitors use two auriculars, they are isolated from their environment and the collaborative and social experience is lost. The evaluation of the prototype has been positive, with a balance expenditure of time in the electronic books and in the real artworks.

Zancanaro et al. [6] have implemented kinematics techniques for the visualisation of details of artworks in a prototype implemented as a multimedia guide for the frescos at Torre Aquila, a tower from the Castle in Trento. Each fresco includes different panels that represent each month of the year. The multimedia guide has been implemented on a PDA using Macromedia Flash. The multimedia presentation includes audio comments followed by a sequence of images that are visualised on the PDA in order to help the visitor in identifying some details of the frescos that are explained through audio.

The Electronic Guidebook [7] describes the design of a study of visitors to a science museum who are equipped with wirelessly connected handheld devices. The museum exhibits are augmented with information and services in the form of web pages and the users can access those pages conveniently when in proximity of the exhibits as well as from their desktops outside the museum. The goal of the study is to examine use of technologies for “bridging the physical and virtual worlds” in the Exploratorium in San Francisco. The Electronic Guidebook project focused on three simultaneous strands of investigation: information technology infrastructure, human computer interface issues and content development.

## **RESEARCH AND TECHNICAL DEVELOPMENT**

The audiovisual content will include several formats and types of multimedia such as images, text, videos, maps, physical models and 3D reconstructions. Such information will be indexed, stored, managed, retrieved and visualised using state-of-the-art technology such as Virtual Reality (VR) on desktop computers, mobile devices, Internet and Geographical Information Systems (GIS) technology.

## Technological issues

The use of VR techniques will be key in order to achieve high quality visualisation and interactivity between the user and the 3D models. VR gives the user the possibility to explore new means of expression and cognition, through innovative ways to interact with content and to learn in informal scenarios. NETConnect will use standard desktop set-ups instead of immersive and expensive virtual environments encouraging low-cost robust approaches, usually more suitable for large number of visitors as in the case of archaeological sites.

Internet technology will be used to remotely access content both for expert and non-expert users. Therefore, it will be possible from one archaeological site to browse material and content about the other related sites. GIS technology will be used as new means to present cultural content to European citizens in a more engaging way, stressing intercultural aspects at the territorial level at the same time. GIS technology has become a widespread tool for the management of information in authorities responsible for the administration of cultural heritage as well as for scientific research especially in archaeology. For this reason, the project will explore the combined use of GIS systems and mobile technologies to allow in-situ access to GIS-based information. Due to the rapid development of mobile technologies and the increasing capabilities of mobile devices, this information will not only be available for experts but be intuitively accessible for the laymen on the own mobile phone, thus bridging technical obstacles in the access to cultural information.

## Implications at cultural heritage community level

NETConnect aims at introducing the history and culture of ancient populations to the largest possible number of users (citizens, experts, and cultural operators). Therefore, an International network of experts on archaeology and VR/GIS technologies will be established in order to link the activities of NETConnect with ongoing research projects, organisations and institutions already working on the topics and to make visible the results of the project to the wider public.

The network, called **NET-IN-TECH** “NetConnect International Network on new Technologies in Europe for Cultural Heritage” [1] will involve all partners of the project and will act as catalyser for other institutions who are interested in the initiative. NET-IN-TECH planned activities will include traditional as well as virtual exhibitions in each of the cultural scenarios locations, demonstrations of technology in VR labs of the partners during dissemination events, promotion of dedicated workshop during international conferences, biannual issue of a network newsletter.

## SCENARIOS OF THE CULTURAL NETWORKS

NETConnect aims at a “pan-European” vision of culture through the research, interpretation and reconstruction of three different cultural scenarios and their mutual interconnections:

- 1) Magna Graecia Southern Italy
- 2) “Glauberg” in Hesse, Germany
- 3) Lusatian culture – Biskupin, fortified settlement Early Iron Age, Poland

The *leit motiv* is to investigate and underline the parallels developments of the three sites. In fact, broadening of knowledge about the development of the past and a

common European heritage is among the objectives of the project, in order to enhance the possibilities to get access to this knowledge on-site and off-site.

The work will start from historical evidence that at the time of the emergence of Celtic “princely sites” north of the Alps, in some cases ca. 100 years earlier, the Greek cities of Sybaris, Zhurrii were founded and ca. 100 later, than the settlement of Biskupin existed. Still the influence of Mediterranean developments on the situation is under discussion. At several times and in different regions, the impact of social, economic and environmental changes always caused new ways of living. The practice of agriculture made people settle down and the emergence of new social systems sometimes caused the development of new settlement structures. Sharing the information about sites (connected with a common specification), spread all over Europe, links the past with the present and can give an idea of a future Europe without frontiers – frontiers in thinking and frontiers as borders and differentiation between countries. For this reason, exploring interconnections between the three different scenarios through the use of new IT technologies is of primary importance for the project.

### Scenario 1: Magna Graecia (Italy)

One of the aim of the project is to design and develop a virtual journey through archaeological sites of the ancient Magna Graecia. The virtual journey will support many and significant archaeological sites, offering innovative products for the exploitation and promotion of the Magno-Greek Cultural Heritage, with particular reference to the Calabrian poleis, as Lokroi, Sybaris, Skilleton, and Kroton.



Figure 1. The archaeological site of Lokroi (Magna Graecia).

The archaeological site of Lokroi has been chosen as a first validation scenario by the implementing of its several environments (theatre, agora, house, temple, etc.): regarding the digital reproduction of public or sacred buildings, such as theatres or temples, documentation is very rich, because almost intact monuments of the same age are present in the Magno-Greek area (for example Paestum and Agrigento). The documentation for this kind of modelling consists of a database (images, texts, paintings) obtained through an extensive bibliographic research. The data have been

categorised for easy finding according to the archaeological site, historical age, and bibliographic source. Moreover, they have been analysed by historians and archaeologists to obtain a congruent and organic overall composition. In fact, the activity of virtual reconstruction of an archaeological site requires a close collaboration between technological experts/researchers in multimedia environments and cultural operators in order to design and develop a realistic and historically correct virtual representation.

For the Lokroi settlement documents depict an archaeological site (founded between the VII and the VIII century b.C.) of about 230 hectares (Figure 1), and surrounded by 7 kilometres of walls. These walls, still present in many parts, have a rectilinear course, from the plain to the fortifications on the hill tops of Castellace, Abbadessa and Mannella, and draw a rectangle that reaches the coast. They are 6 metres high and 3.5 metres wide, consisting of sandstone or limestone blocks, superimposed without binding substances.

The urban districts show a regular scheme, rationally planned, which is characterised by a set of parallel streets, 4.5 metres wide, called *stenopoi* (the term means “narrow streets”) creating districts of a lengthened rectangular shape (about 27 metres wide). The set of *stenopoi* crosses a few large streets, 14 metres wide, called *plateiai* (the term means “large streets”): one of these roads can be identified near the walls, in a direction parallel to the coast; another one forms a natural path along the Ionian coast. The districts consisted of little houses that were attached to each other and probably had a productive rather than a living function. The most investigated district is Centocamere.

For this site a variety of GIS data (Figure 2) has been provided, such as maps, the complete ArcMap project with all thematic layers, and all Locri shape files:

- Local Orthophotos;
- Boundaries shape file, used to delineate the Locri area;
- Shape files of monuments and area of Interest;
- Georeferenced raster images.



Figure 2. An aerial picture of the site of Locri.

The ease of access to the virtual journey will contribute to the spreading of the ancient culture of Magna Graecia at European level. In fact, among many Magna

Graecia sites, the project will take into consideration only those having a high archaeological relevance, but being known just among experts.

### Scenario 2: Early Celtic culture – “Glauberg” (Hesse, Germany)

The Iron Age Glauberg is one of the most known Celtic monuments in Germany. It is a typical place of empowerment of a certain Celtic social group, which shows similarity to other sites in Central Europe. It is articulated in a combination of fortified, mostly hilltop settlements together with richly endowed tombs, often associated with an impressing grave mound, sanctuary or other monuments demonstrating some kind of political power and influence. Imported goods from distant regions like Italy or the Baltic Sea could be interpreted as wide-ranging contacts and trading activities. These sites can be addressed as an example of early complex and elaborate structuring of landscape and defining larger territories. Today the Glauberg site is under archaeological and environmental protection. Traces of archaeology can be found in the landscape. Though many questions are still open, and some will never be answered, enough information is refined to give ideas of the Celtic Glauberg to the public.

All over Europe in the early Celtic Age (at the mid-1<sup>st</sup> millennium B.C.) we can see developments of centres associated with some kind of social change. In Early Celtic time sites like the Glauberg in Hesse, the Heuneburg in Baden-Württemberg or the Mont Lassois in Burgundy – apparently concentrate administrative, economic and cultural functions. To explain all the change in landscape and in the archaeological sites within, connected to this social change, is a complicated process, even with archaeologists as addressees. It of course is a much greater challenge when addressing the public. NETConnect is enhancing the reconstruction and its intelligibility through the use of VR and GIS techniques.

The main goal for the Glauberg scenario is to visualise the ancient landscape of the Wetterau, Hesse with its archaeological sites (settlements and graveyards) with the main focus on the central site of the Glauberg (hill fort and grave mound). The user will be able to find information about the sites in their environments in different phases of the development and to understand growing and decline. Next to this, the Celtic sanctuary with its calendar function and the tombs of local leaders will be visualised.

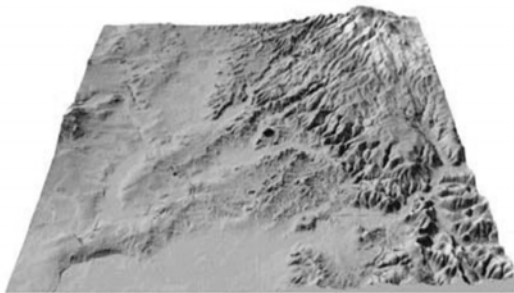


Figure 3. Surface model of the area.



Figure 4. Detailed 3D model of site.

The Glauberg is one of the best researched places in German, geomagnetic surveys of more than 20 km<sup>2</sup>, field surveys, excavations and meta analysis (like archaeobotanics, astrophysics, GIS analyses, material analysis during restoration of finds etc.) revealed a great range of answers to many questions but also revealed new questions.



And research is still in process. At the moment, a wide range of information has been supplied with regards to plans of excavations, topographical maps such as:

- Topographical Maps TK 1:25,000.
- Georeferenced maps of site and features.
- Site Maps with location of monuments.
- Georeferenced Geomagnetic plans of the whole surveyed area.
- Surface Model: of site, of area Wetterau, grid width 25 m.
- Aerial photographs.
- LIDAR 3D-Scan will provide an exact base surface. The reconstructed 1:1 grave mound, ditches and wall form the supposed size of objects in the future model (except of one ditch which has got the wrong location).
- 3D imagery.

### Scenario 3: Lusatian culture – Biskupin (Poland)

The Iron Age fortified settlement in Biskupin is the most famous settlement in Central Europe, belonged to the so-called Lusatian culture, which appeared on the huge territory of Europe in the Bronze Age and developed until the Early Iron Age. The settlement was placed on a peninsula of the Lake Biskupin, located in central part of Poland. The site is dated on the ground of dendrochronological analyses. Most of the wood constructions were built during one winter, in 738/737 BC and existed more than one hundred years. The settlement was surrounded with wood rampart with breakwaters. Inside, there were 13 rows of huts, together about 102–105 houses, which were situated along 11 streets. Biskupin had about 800–1,000 inhabitants. Biskupin was discovered in 1933 by Walenty Szwajcer, young teacher of local school, who saw, during an excursion with his pupils to the Lake, some stakes at the side of the lake.



Figure 5. A view of the Biskupin site.

The idea of presenting archaeology to the public on a large scale began in Poland together with the Archaeological Festival in Biskupin, more than ten years ago. The Festival was organised by staff from the Biskupin Archaeological Museum and the Institute of Archaeology at Warsaw University. The developing Museum carries many conservation projects for which it has been recently honoured with the *Europa Nostra* Medal. In the present world, where the Internet, computers and computers games are visible to people at every moment, we should take advantage of interactive graphics to

bring history and archaeology closer to the public. What is experienced, an add-on to the current visit, suggests the possibility of developing interactive virtual journeys through the fortified settlement in Biskupin, based on archaeological sources. This would be really important for educational purposes, providing the mass public with an alternative means to visit the site, since Biskupin has more than 450.000,00 visitors per year.

The virtual travel will present the whole settlement (process and technology of building houses, wooden ramparts, roads, etc.) and the inside of some houses giving the possibility to visit each “room”, where it would be possible to see how a vertical loom was used, for example. 3D-models of artefacts found during excavations in Biskupin and video presentations of experimental archaeology will accompany the journey.

## CONCLUSIONS

The ever-expanding growth in cultural tourism is raising new issues within the tourism and leisure sectors. International tourist arrivals in 1995 were 563 million and are expected to reach 1.6 billion by the year 2020. These forecasts are based on a conservative growth rate, and actual figures may be significantly higher. There is a growing concern about the conservation of Cultural Heritage and an increasing focus on the need to control the physical impact of tourism on heritage sites. An example of this concern was seen at a recent summit meeting in Santiago, where world leaders approved a Global Code of Ethics for Tourism with the intention of protecting the earth's natural environment and cultural heritage from the non-stop growth of international tourism.

This situation poses new and increasing acute problems for those charged with the twin tasks of both exploiting and conserving our architectural heritage. While these roles have worked closely for many years, there is now a very real danger that these two functions will become mutually exclusive as a critical mass on the demand side is exceeded. Heritage operators are now looking to the new emerging information technologies as a possible way of addressing these needs.

NETConnect is trying to tackle some of these issues by proposing extensive use of new IT technologies to promote better fruition of Cultural Heritage. This will be achieved using technologies deployed by technologists and archaeologists for three key scenarios representing the core of an international network of interconnected cultural scenarios called **NET-IN-TECH** “NetConnect International Network on new Technologies in Europe for Cultural Heritage”. This paper describes the rationale of the project, its latest achievement and its goals and its relevant initiatives.

## ACKNOWLEDGEMENTS

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